

NPIC D-61-6

MEMORANDUM FOR: Assistant Deputy Director (Intelligence) for
Management

SUBJECT : Research and Development Project Approval Request
for Photographic Light Pattern Analysis

REFERENCE : DDCI Memo RM 63-86121, dated 23 December 1963;
Approval of Research and Development Activities

In compliance with paragraph 5.b. of the reference, it is
requested that the Project for Photographic Light Pattern Analysis
outlined in Annex A be approved.

ARTHUR C. LINDAHL
Director
National Photographic Interpretation Center

APPROVED:

Paul A. Borel
Assistant Deputy Director (Intelligence) for
Management

3 April 64
Date

Distribution:

- Orig & 1 - AS/LB/NPIC
- 2 - Director, NPIC
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- 2 - P&DS/DB, NPIC

NPIC:P&DS/DB (1 April 1964)

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ANNEX A

Research and Development
Project Approval Request

I. Identification.

This project is included in the NPEC financial plan under Special Techniques and Development Studies of the Technical Development Program for fiscal year 1964. It was programmed at a [] level of effort. Its internal designation is "Photographic Light Pattern Analysis".

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II. Objectives.

The requirement for this effort arises from a probable future need for reconnaissance of certain critical target situations during hours of darkness to determine changes in activity levels.

This proposed study is needed to assess the intelligence yield and the interpretability of photography of target light patterns at night. It should also determine if additional target information can be gained from light pattern photography over that obtainable from normal daylight photography.

III. Background.

Clandestine military build-up of an area is sometimes attempted under cover of darkness in order to prevent daylight photographic reconnaissance of the build-up activity. Currently, there are few reliable reconnaissance tools to detect this night-time activity.

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During 1963, initial research indicated that certain lights and light patterns could be photographed, at least from low and medium altitudes. Subsequent interpretation indicated that many of these light patterns could be related to target activity. However, the initial research was limited to a feasibility type of project and did not provide sufficient material for a valid assessment of the applicability of these techniques.

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IV. Technical Specifications.

The proposed extension of this project has been planned as four phases. Phase I is the feasibility study already completed. Phase II will be: (a) to acquire a better camera system than used in the feasibility study; (b) to optimize film sensitivity for recording lights; and (c) to conduct ground and air tests to optimize the camera/film system. Phase III will include: (a) flight tests over selected targets in the Sacramento area; (b) photographic analysis of the acquired material; (c) collection of ground truth of the target areas (ground truth will include data concerning light wattages, reflectors, height above ground, orientation and characteristics of terrain or objects illuminated); and (d) correlation of ground truth data to imaged light patterns. Phase IV will include: (a) test flights over other types of targets of interest, specifically AE installations; (b) ground truth collection in these target areas; and (c) data correlation. A sequel to this work is projected which will acquire night light photography over selected targets in San Diego. This additional phase is being correlated and coordinated with another program involving night infrared imagery. This coordinated effort will allow a comparison of the intelligence yield of two different types of night reconnaissance systems over identical targets.

V. Contractor and Financial Arrangements.

Last year a effort (Phase I) was sponsored by OSA, contracting to [redacted] It was agreed, however, that NPIC should support the continued effort since most of the proposed project involves questions relating to the exploitation of night light photography. Therefore, it is recommended that [redacted] be awarded an extension of this original contract. The total estimated cost of this project is [redacted] Of this total, OSA will spend [redacted] for camera development and NPIC will support the remainder of the program for [redacted] The project will be completed within six months.

VI. Coordination.

This project has been coordinated with OSA and DD/S&T and the objectives were presented at the semi-annual Joint Procurement Meeting in February.

VII. Security.

This is an unclassified project, however, Agency interest in the project is classified Secret. The contractor's project manager holds the proper Agency clearances.

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NPIC/IDC/M-11-64

9 April 1964

TECHNICAL DEVELOPMENT COMMITTEE

MINUTES

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1. Announcements

a. The Chairman announced that the Minutes of the previous meeting had been noted and approved by the Executive Director on 6 April 1964.

b. It was announced that the Plans and Development Staff has received ten new proposals for evaluation and the members of the Technical Development Committee are invited to read them if they so desire.

2. Discussion of New Business

a. A Modified Light Table with [] DynaZoom Mount for TID - The []

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A Staff Study was prepared by [] recommending that a system be devised for mounting DynaZoom microscopes on a [] Light Table. The committee members concurred in the recommendation that the NPIC sponsor an [] fixed price contract for the subject modified light table.

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b. Design and Development of Advanced Concept High-Resolution Step-and-Repeat Contact Printer - []

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[] stated that since the DDCI Memo ER 63-88121, dated 23 December 1963, (Approval of Research and Development Activities) and, Chief, Administrative Staff, O, DD/I, Memo dated 4 February 1964, (same subject) specify the form for submission of Research and Development Project Approval Requests, the staff study formerly used will be replaced by the new format. In this way the administrative paper work required for approvals will be kept to a minimum. The Project Approval Request can be forwarded to Headquarters or to Mr. Lundahl, depending on the amount of money involved in the project.

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GROUP 1
Excluded from automatic
downgrading and declassification

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25X1 A Research and Development Project Approval Request, prepared by []
25X1 recommended that an [] contract be awarded to []
25X1 tion in the amount of [] for a step-and-repeat printer. []
25X1 objected to the wording in the Project Approval Request. Specifically, he
25X1 felt that a statement contained in the Background paragraph was incorrect
25X1 because NPIC uses the LogE Printer for most work. The controversial state-
25X1 ment was: "To the present, virtually all prints are being produced by
25X1 means of a continuous strip printing technique in which the original and
25X1 the duplicating material are brought into contact over a revolving drum
25X1 and exposed from a light source directed towards the drum's outer surface
25X1 through a slit aperture." He felt that three requirements under Technical
25X1 Specifications were unnecessary. These requirements were (1) Automatic
25X1 operation, (2) a printing rate equivalent to 25fpm and (3) automatic dodging.
25X1 He also felt that the apparent discrepancy in the price shown in paragraph I
25X1 of [] and that stated under Paragraph V - of [] should be
25X1 clarified to show that there was a price reduction due to GIMRADA's purchase
25X1 of the second printer. The considerable discussion that followed did not
25X1 result in any general agreement on the points of controversy. []
25X1 suggested that the Project should be further coordinated with PSD, TID and
25X1 other interested elements. [] then recommended that this item
25X1 be deferred until the next meeting. The committee members agreed in this
25X1 recommendation.

c. Dovetail Rhomboid for Zoom 70 Stereoscope - []

25X1

25X1 A Research and Development Project Approval Request was presented
25X1 recommending that an [] contract be negotiated with []
25X1 [] in the amount of [] for modification of a Zoom 70 Stereoscope.
25X1 The committee members concurred in this recommendation.

d. Photographic Light-Pattern Analysis - []

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25X1 [] made the announcement that this proposal was coordinated
25X1 with DD/S&T and has been sent over to the DD/I (Management) for approval.
25X1 It deals with an investigation of the intelligence yield of photography
25X1 of Night-Light Patterns. NPIC was requested to undertake the analysis
25X1 phase of this project. There was no discussion on the project.

e. Automatic Stereo Correlation Study - []

25X1

25X1 A Research and Development Project Approval Request, prepared by []
25X1 [] was discussed at the meeting. Copies of the Project Approval Request
25X1 are being distributed with these minutes since they were not reproduced in
25X1 time to accompany the agenda. The committee members concurred in the recom-
25X1 mendation that [] be awarded a contract in the
25X1 amount of [] basis.

3. Evaluation of Contract Proposals.

The following proposals have been evaluated to be of no interest at the present time:

178/63 - A Proposed Study Program for Evaluation of the [] Electron
Beam Readout Process for Photographic Interpretation - []

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Evaluation of Contract Proposals (Continued)

- 210/63 - Modify [] Enlarger for [] Automatic Dodging & Exposure Control - []
- 7/64 - Technical Proposal No. 3200-928. - 1 Modified KA-18A Camera, Still Picture with 3 inch Stereo Lens Cone; 1 Tri-Color Viewer - []
- 15/64 - Consulting Services of [] for specialized photogrammetric problems - []
- 16/64 - Study Program to explore application of the liquid gate principle to lens design - []
- 20/64 - Electronic printer which converts a photographic image on a CRT. Can be used for either viewing or recording on a photographic film. - []
- 33/64 - Design Specifications for the Piamtir System as directed under T.O. 5 of [] - []
- 39/64 - Photographic-Infrared Ground Truth Study - []
- 45/64 - High Resolution, Step-and-Repeat Contact Printer - []

[]
Executive Secretary

NOTED: _____
Executive Director, NPIC

Date

Attachments: C, D and E for Assistant for Administration Only.

- A. Research and Development Project Approval Request - Automatic Stereo Correlation Study, []
- B. Recommendation Sheet
- C. A Modified Light Table with [] DynaZoom Mount for TID. []
- D. Design & Development of Advanced Concept High-Resolution Step-and Repeat Contact Printers. []
- E. Dovetail Rhomboid for Zoom 70 Stereoscope. - []

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Research and Development
Project Approval Request

I. Identification

This project would have been under the category in NPIC's financial plan entitled "Viewers and other Photo Interpretation Equipment." It was not specifically included in this plan because the need for it developed through implication and was further defined in the progress of another development.

II. Objectives

The proposed project is required to determine feasibility of a system which was devised at [] for maintaining automatic registration and magnification compatibility of stereo images being scanned on their High Performance Stereo-Viewer. Such a system is needed to relieve the P.I. from eyestrain and from complex and tedious manual operations while scanning stereoscopic images. The project will involve the fabrication of a breadboard which must demonstrate that the system meets performance goals and can be sensibly incorporated into the High Performance Stereo-viewer.

III. Background

The scanning, roll-film stereo-viewer is still far from a practical, operational reality. There are significant prototypes to be delivered in the near future which will serve as test-beds for determining usefulness and deficiencies. One is the Rear-Projection Stereo-Viewer to be delivered by [] by May 1964; the other is the High-Performance Stereo-Viewer scheduled for delivery by [] in August 1964. Neither of these devices completely overcomes the problem of scale and shape variations -- characteristics of reconnaissance photography -- which induce not only deviations in registration but also non-fusible stereo fields as the operator attempts to scan over the stereo model. Both systems contain means for manual compensation by the operator, and the [] Viewer will have a system for automatically approximating compensations for scale and orientation differentials. However, it has been apparent for some time that, before stereo-scanning can be properly evaluated or exploited, a completely automatic system for maintaining stereo-image registration and shape compatibility is mandatory. In the past, technological developments in this area have not suggested feasibility, but it now appears that such a system is attainable. [] has proposed a technique which is particularly related to their viewer. If this automation can be developed and adapted to their viewer, a significant break-through will be achieved in this realm.

IV. Technical Specifications

This development will include a breadboard which comprehensively simulates the scanning/viewing operation of the [] High

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Performance Stereo-Viewer. To this will be added components designed to sense orientation and scale relationships of conjugate stereo-images and provide the necessary error signals to servo-systems for the purpose of maintaining tolerable limits for scanning. The system will be capable of sensing and maintaining these relationships for the following variables:

1. X and Y translation.
2. θ rotation.
3. M magnification (scale).

It must be capable of maintaining these relationships in spite of considerable variance in shape (tilt and panoramic) and detail (relief) within the conjugate fields.

V. Contractor and Financial Arrangements.

25X1 [] is the contractor for this development program. Since the requirement called for a specific application to their equipment which was already under development, no other firms were invited to bid (pending the evaluation of their proposal). Nevertheless, the state-of-the-art in this realm has been investigated at []

25X1 [] None of these companies has yet developed a system which is appropriate to the [] Viewer. Should proposals for a general-purpose system be invited, these companies would be well-qualified to bid. The cost of the [] study is []

VI. Coordination.

The work of GIMRADA, AMS, RADC and ACIC in developing automatic stereo-plotting systems has been reviewed, and the efforts of the contractors most highly recommended by these agencies have been evaluated. The need for such a system has been verified through conferences with other development groups and operational photo interpreters.

VII. Security.

25X1 Because of association with the sponsor, this contract is to be classified [] the contractor is qualified to hold such contracts.

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ATTACHMENT B

TECHNICAL DEVELOPMENT COMMITTEE

RECOMMENDATION SHEET

The following items have been reviewed by the Technical Development Committee and are recommended for approval:

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APPROVED: _____
Executive Director, NPIC

Date

b.

25X1

APPROVED: _____
Executive Director, NPIC

Date

c.

25X1

APPROVED: _____
Executive Director, NPIC

Date

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SUMMARY

25X1 A report issued by [] on August 1, 1963, conclusively showed
25X1 that light-pattern photography was an excellent and useful tool for
photointerpretation. [] now proposes a three-phase program to
improve and refine the technical and procedural techniques used in
the initial study, so that the intelligence community will have a
reliable and enhanced information acquisition capability.

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PHOTOGRAPHIC LIGHT-PATTERN ANALYSES

1. INTRODUCTION

Recently the initial phase of a program to prove or disprove the gains in photographic interpretation by using light-pattern photography for correlation with normal daytime photography, was concluded.

The details of the photographic system employed, the targets photographed both day and night, the analysis performed by photo-interpreters, and detailed examples of day and night photography, comprise the final report submitted August 1, 1963.

The photographic technology used is definitely a useful tool for photointerpreters to assimilate intelligence information.

We proposed to further evaluate the feasibility of this photographic technique by investigating other types of cameras, exposure intervals, films, and varying aerial coverage.

The technical portion of this proposal discusses the three phases of study separately, even though each successive phase is a logical and closely integrated continuation of the preceding phase.

2. OBJECTIVE

The knowledge and experience gained during the initial phase of the contract will greatly enhance progressive continuance into this new photointelligence technique by exploring additional areas of concern to the photointerpretation community.

Suggestions and recommendations made by the customer and his associates, following the conclusion of Phase I of this contract, will be considered and factored into our new operational plans.

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We proposed to perform the following tasks as an addendum to the completed Phase I:

Phase II - Camera, Film and Flight Tests

- (a) Survey new types of camera systems.
- (b) Make experimental studies of different films.
- (c) Obtain vertical and oblique aerial photography.
- (d) Prepare report on Phase II.

Phase III - Luminaries Data Correlation

- (a) Analyze luminar intensities with the photographic patterns obtained from Phase II.
- (b) Make a comparison study with new photography over a previously photographed area covered in Phase I.
- (c) Prepare a report on Phase III.

Phase IV - Analyses and Final Report

- (a) Select new targets.
- (b) Obtain ground data and conduct flight operations.
- (c) Prepare and submit final report on Phases II, III, and IV, and include copies of the imagery obtained during the program.

3. TECHNICAL DISCUSSION

3.1 Phase II - Camera, Film, and Flight Tests

3.1.1 Schedule of events

Figure 1 shows the project schedule for Phase II.

- (a) Review operational camera systems and photographic films.
- (b) Assemble and prepare camera for operations.

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- (c) Prepare flight plans.
- (d) Perform ground-data collection and flight program.
- (e) Perform photoanalysis and system evaluation.
- (f) Prepare report.

3.1.2 Discussion of phase II.

3.1.2.1 Review of operational camera systems and photographic films

Operational camera systems will be reviewed to establish specification for a simulated system. Studies will be made of different films and methods of increasing film sensitivity for the program.

Ground and air tests will be conducted with selected films. Exposure time and f stop will be varied.

3.1.2.2 Assembly and preparation of camera for operations

A camera closely simulating the operational scale will be assembled. It is proposed to use a 35-mm single-frame recording camera (standard with minor modifications), with an 18 to 25-mm f 1.5 to 3.5 lens. The system will be equipped to perform various types of photographic functions. These functional characteristics are tabulated in Table I.

3.1.2.3 Preparation of flight plans

Flights conducted during Phase II will be flown over local test areas at night, twilight, and during the day. Both vertical and oblique photos will be obtained.

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3.1.2.4 Ground data collection and flight program.

Day, night, and twilight test flights will be made locally to authenticate the system and provide evaluation data for the selection of the optimum camera-film combination. Photography will be made vertically and obliquely. The Cessna 180 aircraft, which was used in Phase I of the program, will be equipped with the photographic system in this program phase.

3.1.2.5 System evaluation

An evaluation of the photographic results will be made and the most effective camera-film combination will be determined.

3.1.2.6 Report

The first report will include prints of the photography taken, both day and night. It will also include complete records of the test procedures, laboratory procedures, and the results. A detailed evaluation of the results will define the most effective camera-film combination.

3.2 Phase III - Luminaries Data Correlation

3.2.1 Schedule of events

Figure 2 shows the project schedule for Phase III.

- (a) Review light patterns from Sacramento River Complex to determine the areas to be studied in detail and study any changes which have come about since the last flight.

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- (b) Select lights on night photos and identify on the day photos.
- (c) Ground check lights for wattages, reflectors, height, and terrain type lighted.
- (d) Evaluate according to detectability and significance.
- (e) Report

3.2.2 Discussion of Phase III

3.2.2.1 Flights

Four flights would be conducted over the Sacramento River industrial complex, one during the day and three at night (2100, 2300, and 0200 hr). These will be over the same area as photographed in the previous phase of the project to update the previous photography. If phase I is approved, the system resulting from that phase will be used. If Phase I is not approved, the Eymo 35-mm movie camera and Royal-X Pan film will also repeat the conditions of the previous flight.

3.2.2.2 Photographic analysis

A comparison analysis will be made to determine any changes which have occurred since the previous flights. Also, if the new camera system is used as determined in Phase I, a comparison of the quality from these versus the previous photographs will be made. Working separately with the day and night photography, it will be possible to determine to what degree the light-pattern photos increase and interpreters ability to detect any changes which have occurred.

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3.2.2.3 Ground-truth data

Ground-truth data will be gathered on the target areas for post-flight evaluation. The data base will consist of the following:

- (a) Conventional daytime aerial photography.
- (b) Topographic maps.
- (c) Luminaries data consisting of the following:
 - Wattages, reflectors, height from ground, orientations, and type of terrain lighted.
- (d) Characteristics of the installations which have been detected in the comparison study.

3.2.2.4 Evaluation

The data collected from the comparison analysis will be evaluated with the ground-truth data to determine the accuracy and significance of the conclusions reached.

The ground-luminaries data will be correlated with the photographs to determine the level of detectability, and the factors involved which affect detectability. The ground data will also be analyzed to determine the characteristics of lights which fall above the threshold of detectability at varying levels.

3.2.2.5 Report

The final report will include prints of photography taken, both day and night, a detailed evaluation of the analysis, and their usefulness in the photointerpretation community.

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A general discussion text will be included to describe the case history of each approach taken in the photointerpretation and correlation methods.

3.3 Phase IV - Analysis and Final Report

3.3.1 Schedule of events.

Figure 3 shows the project schedule for Phase IV.

- (a) New target selection.
- (b) Prepare flight plan.
- (c) Ground-truth data.
- (d) Photographic analysis.
- (e) Final report.

3.3.2 Discussion of Phase IV

3.3.2.1 New targets selection and flight plan

The targets will be selected for this phase of the study. Two of the targets are located outside the local area and one within the local area. A flight plan will be prepared to obtain aerial coverage of the targets four times each during a 24-hour period (1 day mission and 3 night missions). The Cessna 180 aircraft, which was used on Phase I of the program, will be equipped with either the camera system designated by the proposed Phase II or, if this phase is not carried out, by the Eymo 35-mm movie camera and Royal X-Pan film used in Phase I.

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3.3.2.2 Ground-truth data

Ground-truth data will be gathered on the target areas for both pre-flight and post-flight evaluation. The data base and analysis and evaluation of the operational flight photography will consist of the following:

- (a) Conventional daytime aerial photography.
- (b) Geological maps.
- (c) Target folder material.
- (d) Luminaries data consisting of the following:
 - Wattages, reflectors, height from ground, and type of terrain lighted.
- (e) Characteristics of the significant installations.

3.3.2.3 Photographic analysis

The methods of interpretation and analysis to be used in this phase will be essentially the same as used in the original phase of the program. Paper prints of the conventional daytime photography will provide the orientation and annotation base for correlation with ground-truth data. The light-pattern photography will be viewed as positive or negative transparencies, and enlargements will be produced as necessary for scale and format matching with the conventional photographic records.

Separate and combined analysis efforts will be undertaken to evaluate varying levels of target familiarity and reference materials on the significance of the data extracted. Three individual photointerpreters will be assigned in the same manner as before to simulate the following cases:

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(a) Two photointerpreters will work individually on each of the target areas. They will conduct a target evaluation from only the conventional daytime photography in correlation with the light-pattern photography. The only background information on the target areas given them will be a map for orientation purposes.

(b) The next phase of interpretation will require the two photointerpreters to work together on each target area (after each has completed his separate original study) with a limited amount of background information. They will then assess the significance of the light-pattern photography.

(c) The next phase of interpretation will require the two photointerpreters to work together with a third photointerpreter who has the ground-truth data and all available background material on the target areas. They will again assess the detailed significance of the light-pattern photography.

Each of the preceding case histories will be carefully documented and controlled, and the results of each investigation will be evaluated for the degree of information obtained under each situation. Graphic renderings, annotated prints, tabulated data, and general discussion text will be utilized to show the methods and results of this program phase.

The light-pattern photographs will be further examined to determine if any significantly recurring light patterns can be found which might be used as signatures of certain types of targets.

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3.3.2.4 Final report

The final report will document the photoanalysis procedure and a detailed evaluation of the effectiveness of the three-level approaches as described in the photographic analysis section of this proposal.

The report will further include prints of photography taken, both day and night, a detailed evaluation of the photographic analyses, and its usefulness in the photographic community.

A general discussion text will be included to describe the case history of each approach taken in the photointerpretation and correlation methods.

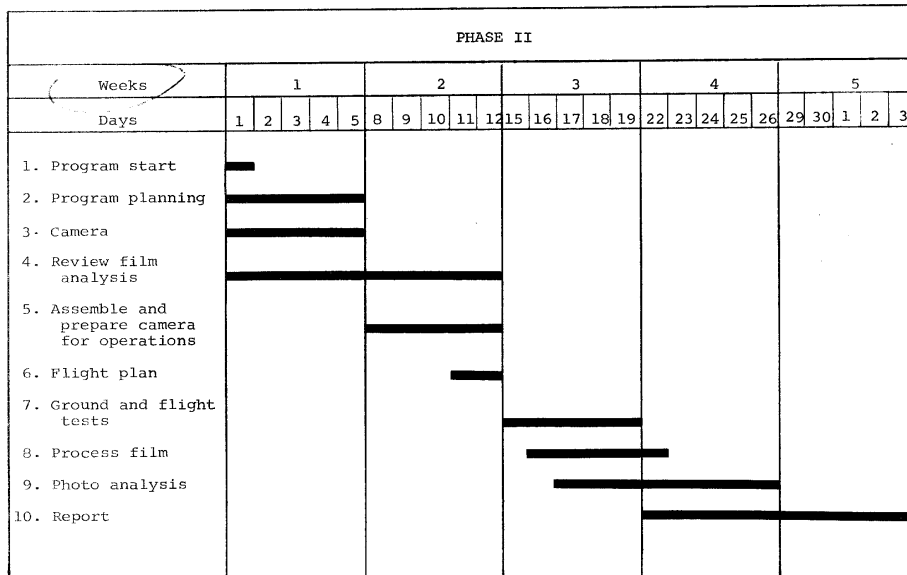


Figure 1.- Phase II schedule.

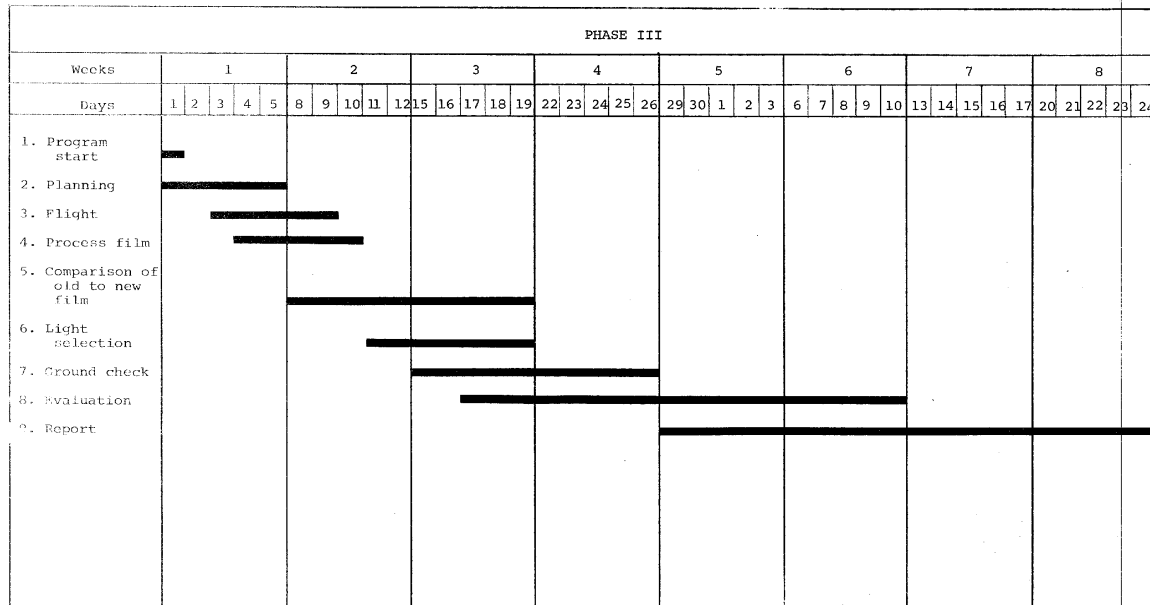
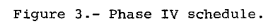


Figure 2.- Phase III schedule.



SECTION 4

COST PROPOSAL

Next 5 Page(s) In Document Exempt

NOTES TO COST PROPOSAL
(CPFF Basis)

Division Proposal No. 3643

October 14, 1963

1. This cost proposal has been prepared on a CPFF basis and is offered as an increased scope of work, defined as Phases II through IV, for the Light Pattern program currently being performed by for the sponsor.

2. The fee rate of 8% proposed herein is consistent with the fee rate for Phase I of the Light Pattern program and with Division's evaluation of the risk and complexity of the effort contemplated.

3. Labor as set forth in this cost proposal is by Division labor grade, representing an average of actual rates within each grade as of June 1963.

4. Since a cost-type contract is contemplated in the event of award, only actual labor costs would be charged to this program, including applicable overhead and G&A.

5. Division's approved billing rates through September 1963 were:

Overhead	135%
G & A	15%

6. Other direct costs identified in this proposal are not duplicated in overhead, G&A or elsewhere.

7. It is anticipated that the present funding available under the sponsors contract with Corporation for Light Patterns, could be applied all or in part to the phases contained in this instant proposal.

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